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INSTRUMENT FOR MEASURING THE SURFACE QUALITY OF GOODS

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References:

1. A. Grott, Miernik polysku typu, GL firmy Zippke. – "Przeglad Papier Papierniezny," 1972, No. 5.
2. USSR Inventor's Certificate No.: 236024, Cl. G 01 B 11/30, 1987 (prototype).

[Claim]

An instrument for measuring the surface quality of goods, which consists of a base and, mounted on it, an illumination system, an optical system for receiving the diffuse component of

the light flux, an optical system for receiving the mirror component of the light flux, and a system for measuring the intensity of the components of the light flux, which is distinguished by the fact that, with the goal of making it possible to measure the smoothness of the surface of paper fabric continuously, the optical system for receiving the diffuse component of the light flux is arranged so that its axis is perpendicular to the base, the illumination system and the optical system for receiving the mirror component of the light flux are arranged so that their axes make up an angle of 20-30° to the plane of the base, and the system for measuring the intensity of the components of the light flux is provided with a circuit to measure the ratio of the mirror component to the diffuse component, the inputs of which are connected to the outputs of the system for measuring the intensity of the components of the light flux.

The invention relates to measurement technology, specifically to optical devices for measuring the surface quality of various goods, and is intended for use in the papermaking industry in cases where it is necessary to make continuous measurements of the smoothness of the surface of paper in the process of producing it.

This need arises, for example, in the making of base paper for synthetic veneer, where the surface smoothness determines the texture of the veneer.

An instrument is known for measuring the surface quality of goods based on measuring two light fluxes—the mirror component and a controlled reference light flux, which consists of a light source, an optical system and a receiver system that contains two photoelements [1].

In this instrument there must be at least two photoelements, in which the photometric characteristics change in different ways in the process of aging, which requires periodic calibration of the circuits of the instrument.

Closest to the invention in technical essence is an instrument for measuring the surface quality of goods that contains a base and, mounted on it, an illumination system, an optical system for receiving the diffuse component of the light flux, an optical system for receiving the mirror component of the light flux, and a system for measuring the intensity of the components of the light flux [2].

The optical system for receiving the diffuse component of the light flux and the optical system for receiving the mirror component of the light flux are arranged so that their axes make an angle of 45° to the plane of the base. The axis of the illumination system is perpendicular to the base.

A shortcoming of the known instrument is the fact that it serves to reveal defective regions of the monitored surface, in connection with which it cannot be used directly for continuous measurement of the smoothness of a moving paper fabric under the conditions of papermaking when there is paper dust in the environment.

The goal of the invention is the possibility of continuous measurement of the smoothness of the surface of a paper fabric.

This goal is achieved by the fact that in the instrument for measuring the surface quality of goods that contains a base and, mounted on it, an illumination system, an optical system for receiving the diffuse component of the light flux, an optical system for receiving the mirror component of the light flux, and a system for measuring the intensity of the components of the light flux, the optical system for receiving the diffuse component of the light flux is arranged so that its axis is perpendicular to the base, the illumination system and the optical system for receiving the mirror component of the light flux are arranged so that their axes make an angle of 20-30° to the plane of the base, and the system for measuring the intensity of the components of the light flux is provided with a block for determining the ratio of the mirror component to the diffuse component, the inputs of which are connected to the outputs of the system for measuring the intensity of the components of the light flux.

The drawing shows a basic block diagram of the instrument for measuring the surface quality of goods.

The instrument consists of base 1, which is in contact with the moving paper fabric 2. On the base are mounted illumination system 3, which consists of incandescent lamp 4, focusing lens 5 and protective glass 6; optical system 7 for receiving the diffuse component of the light flux, which consists of protective glass 8 and phototransistor 9 and which is arranged so that its axis is perpendicular to base 1; optical system 10 for receiving the mirror component of the light flux, which includes protective glass 11 and phototransistor 12; system for measuring the intensity of the components of the light flux, which is made in the form of amplifiers 13 and 14 and which is provided with block 15 for determining the ratio of the mirror component to the diffuse component, the inputs of which are connected to the outputs of the system for measuring the intensity of the components of the light flux.

Illumination system 1 and optical system 7 for receiving the mirror component of the light flux are arranged so that their axes make an angle of 20-30° to the plane of the base.

The proposed instrument operates in the following way.

Incandescent lamp 4 creates a beam of light which is aimed at a specific angle α = 20-30° onto the surface of the paper fabric 2 that is being monitored. The beam of light passes through focusing lens 5, protective glass 6 and reaches the monitored surface of the paper fabric 2, where it separates into mirror and diffuse components.

The diffuse and mirror components of the light flux go to the corresponding optical systems 7 for measuring the diffuse component of the light flux and 10 for measuring the mirror component of the light flux. The mirror component of the light flux goes to the active surface of phototransistor 12 and the diffuse component goes to phototransistor 9.

The signals M (t) and D (t) from phototransistors 9 and 12 are amplified in amplifiers 14 and 13. The output signals E_1 (t) and E_2 (t) from amplifiers 14 and 13 go to the inputs of block 15 for determining the ratio of the mirror component to the diffuse component, where the current value of the ratio E_2 (t)/E_1 (t) is calculated, which is proportional to the smoothness of the paper S (t).

The distinctive feature of the proposed instrument is the positioning of the optical systems for receiving the diffuse 7 and mirror 10 components relative to the surface of the monitored paper fabric 2, which is characterized by the values of angles β and α formed by the axes of these receiving systems and the surface of fabric 2. For angles $\beta = 90°$ and $\alpha = 20\text{-}30°$ a linear relationship is assured between the smoothness of the paper and the ratio S (t) = E_2 (t)/E_1 (t), which serves as a measure of the measured value of the smoothness of the moving paper fabric 2, and also independence of the value of the diffuse component on variations of angle α due, for example, to oscillations and vibrations of fabric 2 as it moves is also assured.

Another distinctive feature of the proposed instrument is the presence of block 15 for determining the ratio of the mirror component to the diffuse component, with which the smoothness of the moving paper is continuously determined by dividing the current value of the signal proportional to the intensity of the mirror component by the signal proportional to the intensity of the diffuse component.

As the block 15 for determining the ratio of the mirror component to the diffuse component one may use a standard analog divider block, a digital divider block or, for example, a digital control computer, if the latter is a part of the automatic system for control of the technological process of the papermaking equipment, with the latter variation being the most promising, since autonomous measurement of the diffuse and mirror components makes it possible to conduct the division operation outside of the instrument, which allows its accuracy to be raised.

The noted distinctive features of the proposed instrument provide the following advantages for it: the measurement process is continuous with output of smoothness measurement results; the ratio-determining block assures determination of the ratio of the mirror component to the diffuse component at the rate of the measurement process; the geometry of the optical systems of the instrument are chosen so as to improve the insensitivity of the measurement results to noise, which is accomplished due to the choice of angles for positioning the axes of the receiving systems with respect to the surface of the paper fabric; the optical systems of the instrument do not require calibration, adjustment, etc., since they are simple in design.

Aging of the photoresistors affects the results of measurement to a lesser degree, since the smoothness of the paper fabric is determined from the ratio of the two components of the reflected light.

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